

REMARKS

By this Amendment, Claims 1-9 are amended, and new Claims 10-20 are added, leaving Claims 1-20 pending in the Application for the Examiner's review and consideration. Reconsideration of the June 24, 2005 Office Action is respectfully requested.

Claims 1-9 have been amended to more clearly recite Applicants' claimed invention. Claim 1 has been amended to more clearly recite that the claimed hydrogen sintering process is applied to a substrate comprising a semiconductor device already formed therein. Claims 5 and 7 have been amended to recite that the device includes a DRAM. Support for this change can be found in the specification as originally filed at page 20, line 7 – page 21. New Claims 10 and 20 recite the formation of hydrogen radicals and hydrogen ions at a pressure of 13.3-267 Pa. Support for Claims 10 and 20 can be found at page 17, lines 1-2 of the specification.

New Claim 11 recites a method of fabricating a semiconductor device including a step of hydrogen sintering wherein an electronic device substrate is exposed to a plasma containing hydrogen. The method of Claim 11 comprises the steps of (i) forming a gate insulation film on a substrate, (ii) forming an electrode of polysilicon on the gate insulation film, and (iii) exposing the polysilicon electrode to an atmosphere containing hydrogen radicals and hydrogen ions, wherein the hydrogen radicals and hydrogen ions are formed by exciting a processing gas containing a noble gas and a hydrogen gas into a plasma.

Support for new Claim 11 can be found in the specification at page 18, line 19- page 20, line 6. New dependent Claims 12-19 recite the subject matter of original Claims 2-9, respectively. As no new matter has been introduced by these changes, they should be entered at this time.

Applicants' invention relates generally to the technology of hydrogen sintering and specifically to the application of plasma-induced hydrogen sintering to semiconductor device fabrication. The process of hydrogen sintering can be used to terminate dangling bonds in insulating layers and at the interface between insulating layers and semiconducting layers in a semiconductor device. By terminating dangling bonds, the electronic performance of a semiconductor device can be improved.

Applicants have discovered that by using a low electron temperature (i.e., low energy) plasma, a hydrogen sintering process can be performed in a plasma environment without damaging the semiconductor device.

The issues set forth in the Office Action are discussed below in the order in which they were raised.

Initially, Applicants submit herewith corrected drawings for Figures 1A-1H in compliance with 37 C.F.R. § 1.121(d). The corrected drawings, which are each labeled "Replacement Sheet" in the header pursuant to 37 C.F.R. § 1.84(c), have been amended to contain the designation "Prior Art." No further correction is deemed necessary.

In response to the Examiner's concern that the Abstract contains English grammar that is unclear and confusing, submitted herewith is a new Abstract in compliance with 37 C.F.R. § 1.72. The new Abstract introduces no new matter.

Claims 1-9 were objected to for containing grammatical informalities. Claim 1 has been amended to correct the grammar therein. Further, Claim 2 was objected to for allegedly being indefinite for containing the relative term "heavy" hydrogen. Applicants submit that the term "heavy hydrogen" is conventional. As is well-known in the art, atmospheric hydrogen is a mixture of three isotopes. The most common is called protium (mass no. 1, atomic mass 1.0078); the protium nucleus (protium ion) is a proton. A second isotope of hydrogen is deuterium (mass no. 2, atomic mass 2.0140), the so-called heavy hydrogen, often represented in chemical formulas by the symbol D. As disclosed in the specification at page 18, lines 10-14, plasma may comprise heavy hydrogen radicals D*, where the asterisk (*) is conventional notation for a radical. Because the terminology "heavy hydrogen" is conventional, no further correction is deemed necessary.

Claims 1-9 stand rejected under 35 U.S.C. § 102(a) as allegedly being anticipated by Applicants' admitted prior art. The reasons for the rejection are set forth on pages 3-4 of the Office Action. For the reasons set forth below, this rejection is traversed.

The Office Action alleges that the subject matter of Claim 1 is recited in Applicants' admitted prior art on pages 4 and 5 of the specification. Specifically, the Office Action alleges that the disclosure at page 5, lines 27-33 anticipates the

formation of hydrogen radicals and hydrogen ions from a noble gas and hydrogen gas using plasma. Applicants respectfully disagree with these assertions.

Pages 4-5 of the specification merely recite background information related to the nature of the problem to be solved. Referring to pages 4-7, the specification discloses thermal hydrogen sintering process (see page 4, lines 1-27), and a wet annealing process (see page 4, line 28-page 5, line 2). Further, the specification discloses plasma dry cleaning and the attendant difficulties with plasma dry cleaning due to high electron temperature (see page 5, lines 3-21). The specification also discloses plasma processes used for the oxidation or nitridation of a surface of a silicon substrate (see page 5, line 22-page 7, line 6). Referring specifically to page 5, lines 27-33, it is clear that the disclosure relates to the technology of direct oxidation or direct nitridation of a silicon substrate using a low electron temperature microwave plasma. Applicants respectfully submit that page 5, lines 27-33 do not refer to a hydrogen sintering process, as alleged in the Office Action.

Applicants note that page 7, lines 1-6 of the specification discloses that the previously-mentioned microwave plasma technique, which was discussed in the context of oxidation or nitridation, may be extended to hydrogen radical formation for hydrogen sintering. Applicants submit that this wording relates to the inventive process of the inventor in the context of the problem to be solved. Inasmuch as this portion of the disclosure is not the work of another, a rejection under 35 U.S.C. §102(a) cannot be sustained. Furthermore, in order to clarify this issue, submitted herewith is a substitute specification in which text of the

disclosure has been be moved. Specifically, the disclosure from page 4, line 1-
page 13, line 5 has been deleted and re-inserted under the heading "Best Mode
for Carrying Out the Invention," starting at page 16, line 9.

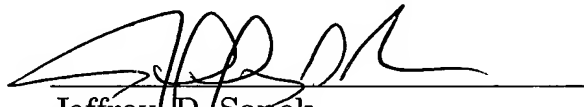
For at least the foregoing reasons, withdrawal of the rejection and prompt
allowance of the application are respectfully requested.

If there are any questions regarding this amendment or the application in
general, a telephone call to the undersigned would be appreciated since this
should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as
a petition for an Extension of Time sufficient to effect a timely response, and
please charge any deficiency in fees or credit any overpayments to Deposit
Account No. 05-1323 (Docket #010986.55104US).

Respectfully submitted,

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Amendments to the Drawings

The attached sheets of drawings includes changes to Figures 1A-1H. The newly submitted Figures 1A-1H have been amended to include the legend “Prior Art.”